obtained with end-on tubes, from 5 to 10 mm. in diameter and about 30 cm. long, with quartz windows, and at pressures in the neighbourhood of 5 mm. The necessary exposure varies from five minutes to an hour, according to the width of the slit, the absorptive power of the medium, etc. I have obtained a beautiful photograph of the absorption spectrum of benzol vapour with fifteen minutes' exposure.

E. P. LEWIS.

University of California (Department of Physics), Berkeley, California, May 18.

The Relation between Chromosomes and Sex-determination in "Abraxas grossulariata."

IN a paper on this subject in the *Journal of Genetics* (vol. iv., June, 1914, p. 1) I gave evidence that in a strain of *A. grossulariata* which I have bred for several years two kinds of eggs are produced, having respectively twenty-eight and twenty-seven chromosomes. Since the somatic chromosome-number is fifty-six in the male and fifty-five in the female, it seemed evident that the eggs with twenty-eight were male-determining, those with twenty-seven female-determining. In this strain some families in each generation consist entirely of females, so it was hoped to prove the correctness of the conclusion with regard to sex-determination by finding that in families consisting entirely of females all the eggs contain twenty-seven chromosomes. I have now examined the eggs of several such families, and find, contrary to expectation, that the equatorial plate of the inner polar spindle contains twenty-eight chromosomes about as frequently as twenty-seven. The new material confirms the observation that twenty-seven occur in one spindle and twenty-eight in the other, but it seems to make it certain that the presence of twenty-eight chromosomes in the inner spindle does not necessarily cause the production of a male—at least, in the strain which produces all-female families. A possible explanation of the anomaly is that in all-female families a chromosome is eliminated at a later stage, but at present I have no direct evidence for this. I have material preserved in the hope of testing this suggestion, but the investigation is likely in any case to be a lengthy one, and circumstances may prevent my continuing it for some months. I therefore make this short statement of the facts as at present known, in order that it may not be assumed that the existence of male- and female-determining chromosomes has been finally demonstrated in Abraxas.

LEONARD DONCASTER.

Zoological Laboratory, Cambridge, June 7.

Cavities due to Pyrites in Magnesium Limestone.

IN some districts it seems that iron pyrites formed an important constituent during the deposition of the Magnesium Limestone—not only in the north of England, but in America also in some of the Magnesium Limestones of the Cambrian age.

The Durham beds at Fulwell Hill Quarry give us ample evidence of this, as regards the English beds, by their very numerous cavities, the shape of which, which cannot be attributed to anhydrite, affords the clue. Unless carefully sought, the salts of iron are not noticed, nor are ferruginous band-stains conspicuous or frequent.

Some years ago I obtained specimens from the Roker Cannon-ball bed; some of them, recently placed in the Jermyn Street Museum, have been examined by Mr. A. F. Hallimond, the assistant-curator, who has labelled them "pseudomorphous after mispickel." These, however, were formed on the outside of the calcareous spheres. I have also secured from the Fulwell Hill Quarry a few specimens of the concretionary structure with cavities containing limonite in powder. There are, however, a large number of empty cavities that apparently once contained pyrites, which are free from the prevalent "marl" powder, from dolomite, or from any traces of anhydrite. They are from about ½ in. up to about 6 in. in diameter, are roughly spherical, but with projecting cones; they are often decorated with strings of white calcite, though occasionally they are iron-stained (see Fig. 1).

Rarely, more or less solid specimens are met with (Fig. 2) which are casts of similar cavities, due to the deposit in them of calcium carbonate. Dr. J. Lister, of the Technical Institute, Tunbridge Wells, has kindly examined these for me, and has found them to contain a notable amount of calcium fluoride, which, so far as I am aware, is a new observation.

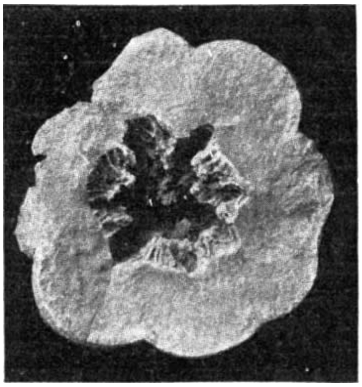


FIG. 1.—Botryoidal mass (section) with cavity. ×½.

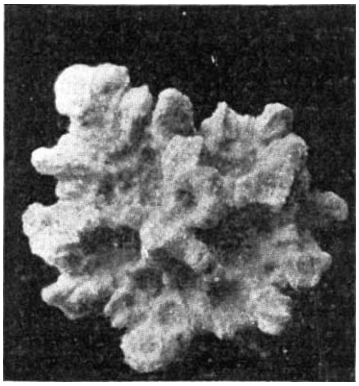


FIG. 2.—Calcite cast of a cavity probably after FeS_2. ×½.

Other kinds of cavities are occasionally met with in the concretions of these beds, but, except the so-called cells, there are no others of frequent occurrence, while these, to which I am directing attention, are found in all the beds, both of limestone and marl. I have seen no traces of copper.

GEORGE ABBOTT.

2 Rusthall Park, Tunbridge Wells, May 12.

POISONOUS GASES IN WARFARE AND THEIR ANTIDOTES.

IN the Concise Oxford Dictionary a "Stink-ball" is defined as "a vessel containing explosives, etc., generating noxious vapours, used formerly in naval warfare and still by Eastern pirates." The Germans have shown the world how science may be degraded in its application to the purposes of the pirate, and our military commanders have now to deal with a new weapon previously unheard of in the field. Steps have already been taken to provide protection for our men, but a survey of the whole question of the composition and the properties of the gases which have been or are likely to be used may be of service at the present time.

The chemical laboratory would be able to provide a very large number of offensive and poisonous gases and vapours, but for practical purposes they would be limited to those which present the following qualities: (1) they must be much heavier than atmospheric air; (2) they must be producible in large quantity in the form of a portable liquid or solid, which in its turn will evaporate rapidly from the containing vessel or otherwise so as to produce the gas; (3) they should not be excessively soluble in water, or much would be lost in rolling over moist ground.

In the newspaper accounts from eye-witnesses of the cloud of gas sent out by the enemy it has several times been described as presenting a reddish colour. If this statement is based on correct observation it is certain that the gas used on these occasions must have contained either bromine or peroxide of nitrogen, both of which have an orange-brown colour. It seems improbable that oxides of nitrogen would be used on account of the cost in the form of nitric acid or nitrate from which they must be produced. Bromine, however, is made from the salts in the Stassfurth deposits, and from this source up to the outbreak of war much of the bromine and bromides of commerce was obtained. Bromine is at common temperatures a liquid, but it evaporates very easily and produces a vapour which is about five-and-a-half times heavier than air. Probably the amount of bromine available would be insufficient for the production of the enormous quantities of vapour required in these operations if used by itself, but as the whole object of manufacture in the present case is not the production of pure bromine but of something that will suffocate, the material used may consist essentially of the closely allied element chlorine, accompanied with a quantity of bromine sufficient to account for the colour.

At ordinary temperatures chlorine is a pale-green gas which is about two-and-a-half times heavier than air. The gas was discovered by the Swedish chemist Scheele in 1774, and has been used for bleaching purposes since the end of the eighteenth century. It acts rapidly on nearly all metals if moist, but when free from water it does not attack the surface of iron, and as it is easily reduced by compression to a liquid, it has been produced commercially in very large quantities for many years past in the liquid state and preserved in iron bottles. There can be little doubt that the gas from which our men have been suffering is sent into the trenches in such cylinders. The gaseous chlorine which escapes from them on simply opening the tap, whether or not it is accompanied with bromine, is quite sufficient to account for the suffering and death which have been the result of getting the gas into the lungs, but other volatile substances have been suggested as possibly available. Thus phosgene, a compound of carbonic oxide and chlorine, is a heavy gas about three-and-a-half times heavier than air, easily liquefiable and easily vaporisable from the liquid, which is a commercial article produced in Germany on a fairly large scale. Sulphur dioxide, often erroneously called surphurous acid, is familiar as the product of burning sulphur, and being liquefiable readily it may be seen in the liquid form in glass siphon bottles in every chemical laboratory.

The chlorides of sulphur, phosphorus, and arsenic are also very irritating and poisonous. The only reason for supposing that these compounds might be employed is provided by a communication from Warsaw which appeared in the *Times* of June 5, in which it is stated that the Germans had been burning straw on which a white powder resembling salt had been sprinkled. The dense smoke carried by the wind over the Russian lines is stated to have produced symptoms similar to those reported from France in the case of victims of suffocation from what is believed to be chlorine or a mixture of chlorine and bromine. The white powder used against the Russians probably contains one of the chlorides mentioned above, which might be made portable by admixture of common salt. The statement in the *Times* that the powder is believed to be some easily-made compound of *chloral* is obviously a misprint.

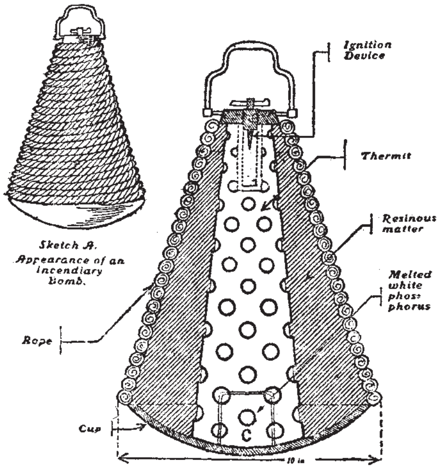
Fortunately all these fumigating agents agree in one particular. They can be absorbed and therefore stopped by passage through or over a strongly alkaline substance to which may be added, especially in reference to chlorine or bromine, a proportion of sodium hyposulphite (thiosulphate), the familiar "hypo" of the photographer. It is important to notice that a strong alkali is necessary and in layers sufficiently thick. When the ordinary housekeeper speaks of "carbonate of soda," the salt known to the chemist as *bi*carbonate is always intended, and this is almost useless.

The masks or respirators supplied to the troops consist of material saturated, though not dripping, with a *strong* solution of common washing soda (the carbonate) mixed with an equal quantity of hyposulphite, to which has been added 2 or 3 per cent. of glycerine to keep the whole damp. A very good material would also be the granular mixture of lime and caustic soda, known in every chemical laboratory as "soda-lime." This would have to be wrapped up in gauze and would not require to contain glycerine.

Many well-intentioned efforts have been made by private persons to supply their soldier friends with respirators made of gauze or muslin containing a receptacle filled with cotton waste saturated with an alkaline solution. Most of these attempts are not only imperfect but really dangerous to the men by leading them to consider themselves protected when practically there is no protection. The pads saturated with alkali are often much too small, and the cotton padding has not been secured in position by proper quilting or otherwise. Moreover, the most efficient solution has not been used. The official protectors take the form of a hood which covers the head and afford a complete protection against the gases, even when concentrated. As they are now being sent to France daily in very large numbers it is to be hoped that the directions of the War Office recently issued will be attended to and no more respirators of other types, either home made or manufactured without official sanction, will be sent to the Front.

It must not be forgotten, however, that the efficiency of all these contrivances is limited, and in the event of being exposed to several successive doses of gas the material ought to be washed in clean water and then recharged with the original chemical mixture. A supply of liquid is now furnished to the men in the trenches.

A question has arisen in connection with the idea of the possible use by the enemy of bombs containing poison, to be dropped by Zeppelins or other aircraft. In the event of such occurrence the best course would be in the first instance to close all the windows and doors of houses in the neighbourhood. Should the smell of chlorine be perceived indoors, a cloth wetted with strong solution of ammonia should be waved about in the air. This would produce a harmless white smoke consisting of sal-ammoniac, and this, even with excess of ammonia, would produce very little if any damage to furniture, etc. With regard to wounds produced by shrapnel or other projectiles containing phosphorus, it is improbable that any of the element would escape combustion in the air. The mischief is caused by the phosphoric acid produced being carried into the tissues, and for this dressings made slightly alkaline with carbonate of soda should be used till all acid has been removed.



SECTION OF INCENDIARY BOMB.

(*a*) The bomb, as a rule, is conical, of 10 in. diameter at the base, corded round, and has a metal handle at the apex (see A). (*b*) The base is a flat cup, on to which a pierced metal funnel is fitted, having the ignition device and handle fitted at the top. (*c*) The funnel is generally filled with Thermit, which upon ignition generates intense heat, and by the time of the concussion has taken the form of molten metal of the extraordinary high temperature of over 5000° F. The molten metal is spread by the concussion. (*d*) Outside the funnel is a padding of a highly inflammable or resinous material bound on with an inflammable form of rope. The resinous material creates a pungent smoke. (*e*) There is generally some melted white phosphorus in the bottom of the cap, which develops nauseous fumes. (*f*) In some cases celluloid chippings are added and occasionally a small quantity of petrol.

The chief result of air raids so far has been the production of fires, and a timely warning has been issued by the British Fire Prevention Committee. As the committee points out, fires are not usually caused by the ordinary explosive bomb. When fire occurs it is due to open lights or fires in the house or to broken gas or electric mains. The incendiary bomb is, however, designed to produce a fierce fire in itself. The accompanying diagram shows the construction of one of the ordinary types of these missiles.

The fumes from such bombs contain a large quantity of phosphoric acid, and when inhaled produce violent coughing, but fortunately they would be completely stopped by a wet cloth. Thermit, in its ignition, produces such a high temperature that the timbers of a house would be certainly inflamed if struck, but when the first burst of flame is over the extension of the fire would proceed in the manner of fires originating otherwise and would have to be dealt with by the fire brigade in the usual way. In the meantime, every house in a threatened area should be furnished with buckets and baths full of water ready drawn to be applied as quickly as possible, in quantity as large as possible, in case of necessity.

W. A. TILDEN.

VISIBILITY.

THE factors which determine the ability of the eye to distinguish an object from its background are not very well known for many of the conditions met with in practice. Our practical experience has taught us that if we wish to see properly under any given condition, the illumination must not be less than a certain amount, and we have been content to provide the necessary illumination without having any very clear idea what are the aids and hindrances to good seeing. A discussion on some aspects of the subject of visibility was initiated at the Illuminating Engineering Society, on April 27, by Messrs. Paterson and Dudding, of the National Physical Laboratory; and many speakers made interesting contributions to it.

Several fields of investigation disclose themselves in connection with the subject, and are mainly concerned with cases in which objects become difficult of discernment. For instance, the conditions required to render troops or other objects invisible to the enemy is a matter which at first sight may appear simple, but if all that is said is true, the problem is a complicated one, and would justify thorough research into it.

It has been stated that if a donkey and a zebra are located in a distant field (and remained there to be observed) the zebra would become invisible long before the donkey. This effect was discussed in an interesting article by Col. F. N. Maude in *Land and Water* for January 30, in which he gave an incident from practical experience of a regiment with pipeclayed belts and accoutrements being invisible by the side of another regiment which had equipment of a more uniform nature.

The question of the visibility of distant faint sources of light at night is the simplest form in which the problem presents itself, because first, the contrast between the light and its background